

^{33}Mg : determination of a negative parity intruder ground state via nuclear moments

Leuven - Mainz - ISOLDE collaboration at CERN

***D. T. Yordanov¹, M. Kowalska^{2,3}, K. Blaum², M. De. Rydt¹, K. Flanagan¹,
P. Lievens⁴, R. Neugart², Wilfried Nörtershäuser² and G. Neyens¹***

¹ Instituut voor Kern- en Stralingsfysica, K.U.Leuven, Leuven, Belgium

² Insitut für Physik, Universität Mainz, Mainz, Germany

³ CERN, Physics Department – IS, Geneva, Switzerland

***⁴ Laboratorium voor Vaste-Stoffysica en Magnetisme, K.U.Leuven,
Leuven, Belgium***

Table of Isotopes in the vicinity of The Island of Inversion

Measured Intruder

This Work

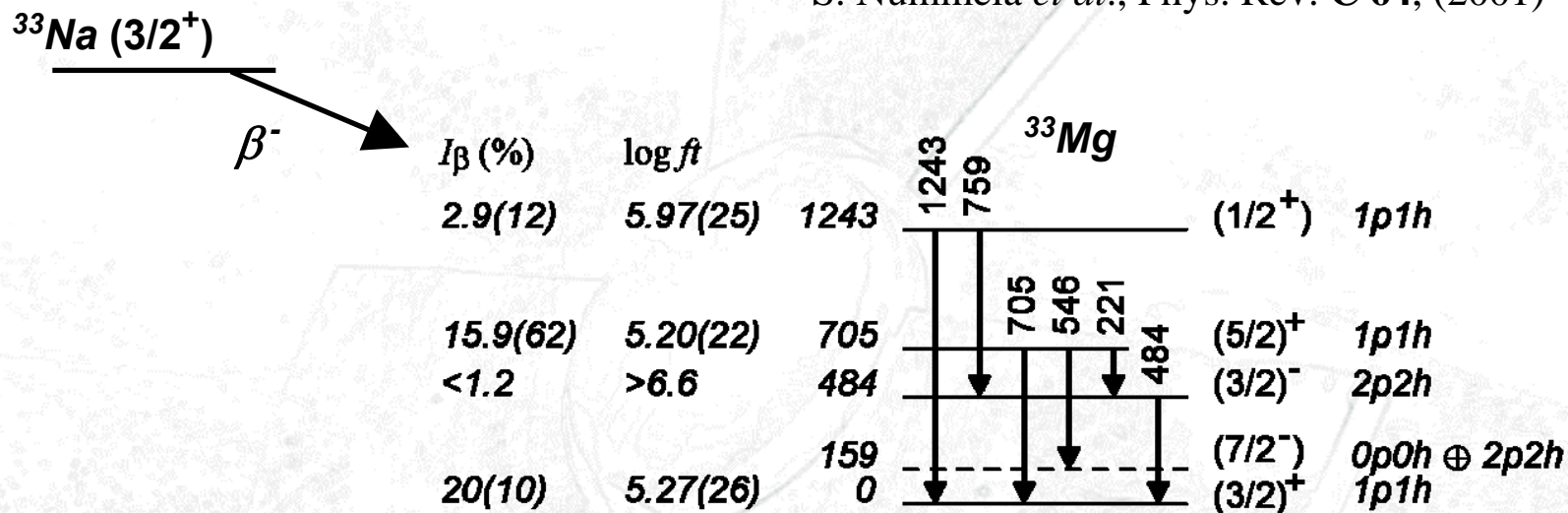
Normal or
not measured

		N=20					
Z=12	13	Al30 3.60 s 3+ β^-	Al31 644 ms 5/2+ β^-	Al32 33 ms 1+ β^-	Al33 42 ms β^-	Al34 56 ms β^-_n	Al35 39 ms β^-_n
		Mg29 1.30 s 3/2+ β^-	Mg30 335 ms 0+ β^-	Mg31 230 ms 1/2+ β^-_n	Mg32 120 ms 0+ β^-_n	Mg33 90 ms β^-_n	Mg34 20 ms 0+ β^-_n
	11	Na28 30.5 ms 1+ β^-_n	Na29 44.9 ms 3/2+ β^-_n	Na30 48 ms 2+ $\beta^-_n, \beta^-_{2n}, \dots$	Na31 17.0 ms 3/2+ $\beta^-_n, \beta^-_{2n}, \dots$	Na32 13.2 ms $\beta^-_n, \beta^-_{2n}, \dots$	Na33 8.2 ms $\beta^-_n, \beta^-_{2n}, \dots$
	10	Ne27 32 ms β^-_n	Ne28 17 ms 0+ β^-_n	Ne29 15 ms β^-	Ne30 7 ms 0+	Ne31	Ne32

Former experimental studies of ^{33}Mg

- β decay: $^{33}\text{Na}, (3/2^+) \rightarrow ^{33}\text{Mg}, (3/2^+)$

S. Nummela *et al.*, Phys. Rev. C **64**, (2001)



- Intermediate energy Coulomb excitation:

484keV: $(5/2^+) \rightarrow (7/2^+)$, $\beta_C = 0.52(12)$

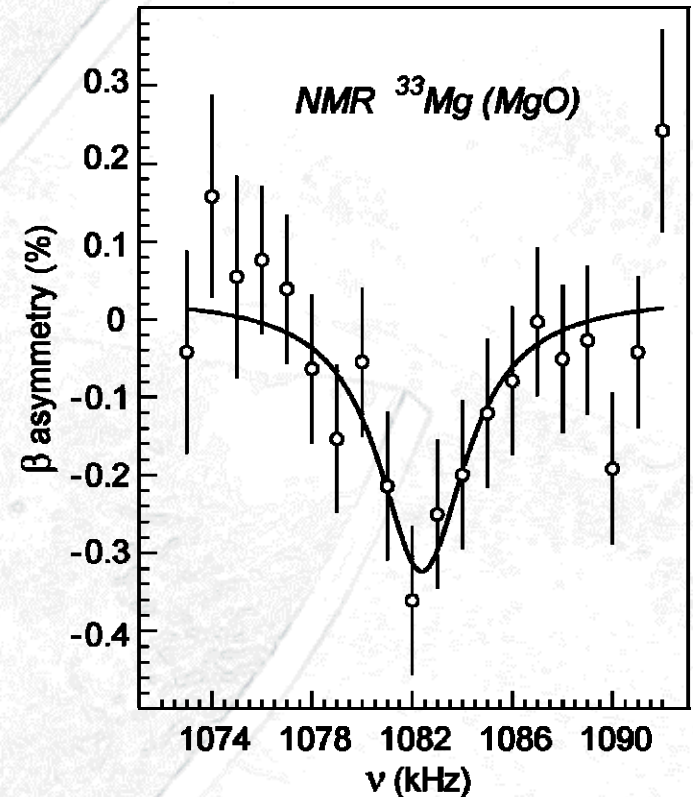
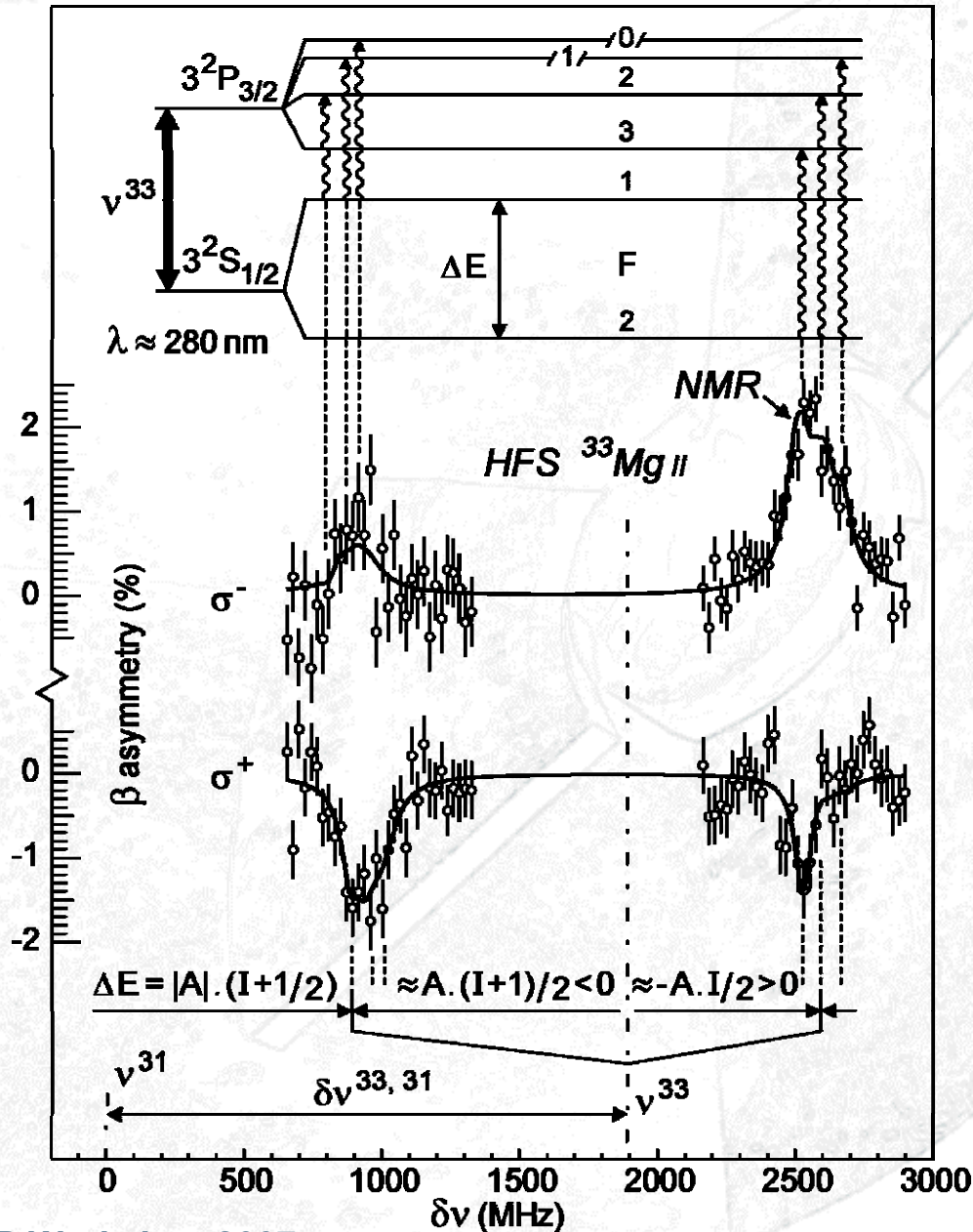
B. V. Pritychenko *et al.*, Phys. Rev. C **65**, (2002)

- Proton inelastic scattering:

484keV, 546keV – parities relative to the ground state, $\beta_M = 0.47(8)$

Z. Elekes *et al.*, Phys. Rev. C **73**, (2006)

Hyperfine structure and nuclear magnetic resonance of ^{33}Mg

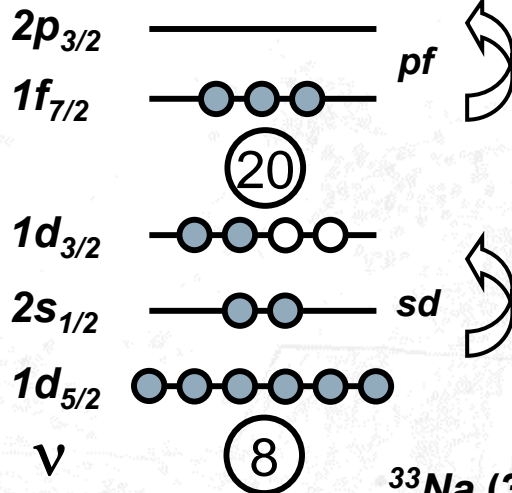


Experimental results:

$$g = -0.4971(4)$$

$$I = 3/2$$

^{33}Mg ($Z=12, N=21$)

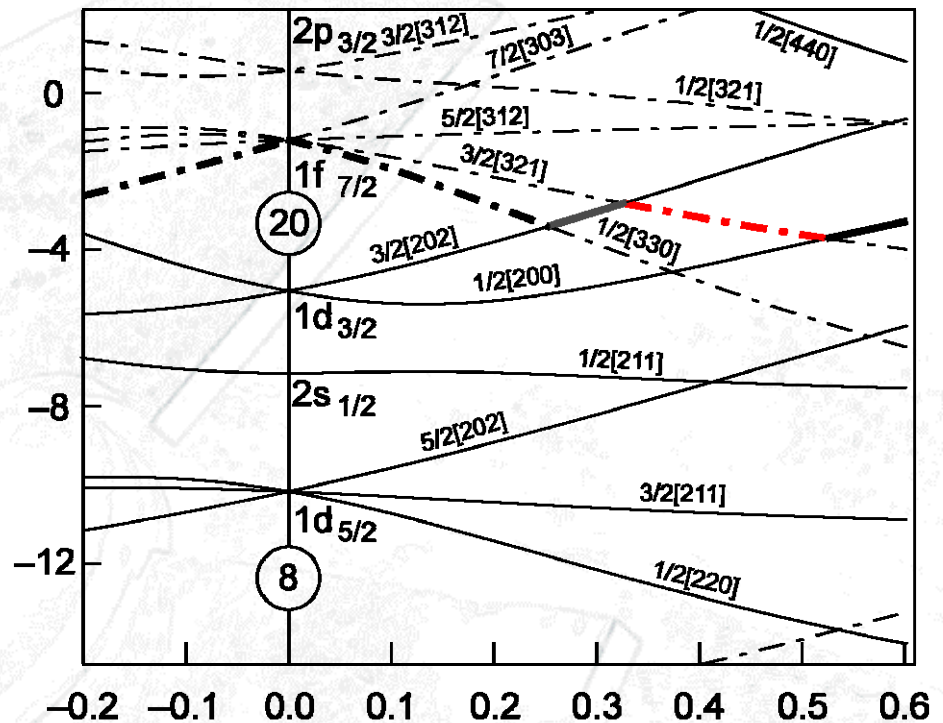


^{33}Na ($3/2^+, 5/2^+$)

β^-

$g = -0.4971(4)$
 $Q_s(\beta_0) = 151(38) \text{ mb}$

n	I^π	WBMB		SD - PF	
		g	$Q(\text{mb})$	g	$Q(\text{mb})$
0	$3/2^-$	-1.47	-83	-1.35	-91
1	$3/2^+$	0.75	135	0.78	140
2	$3/2^-$	-0.45	147	-0.47	157



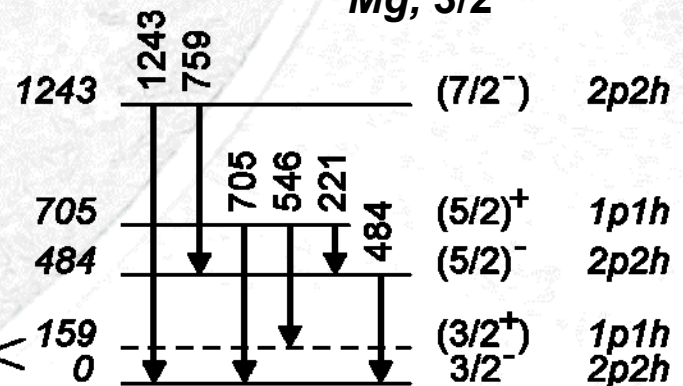
$\log ft$

5.97(25)

5.20(22)

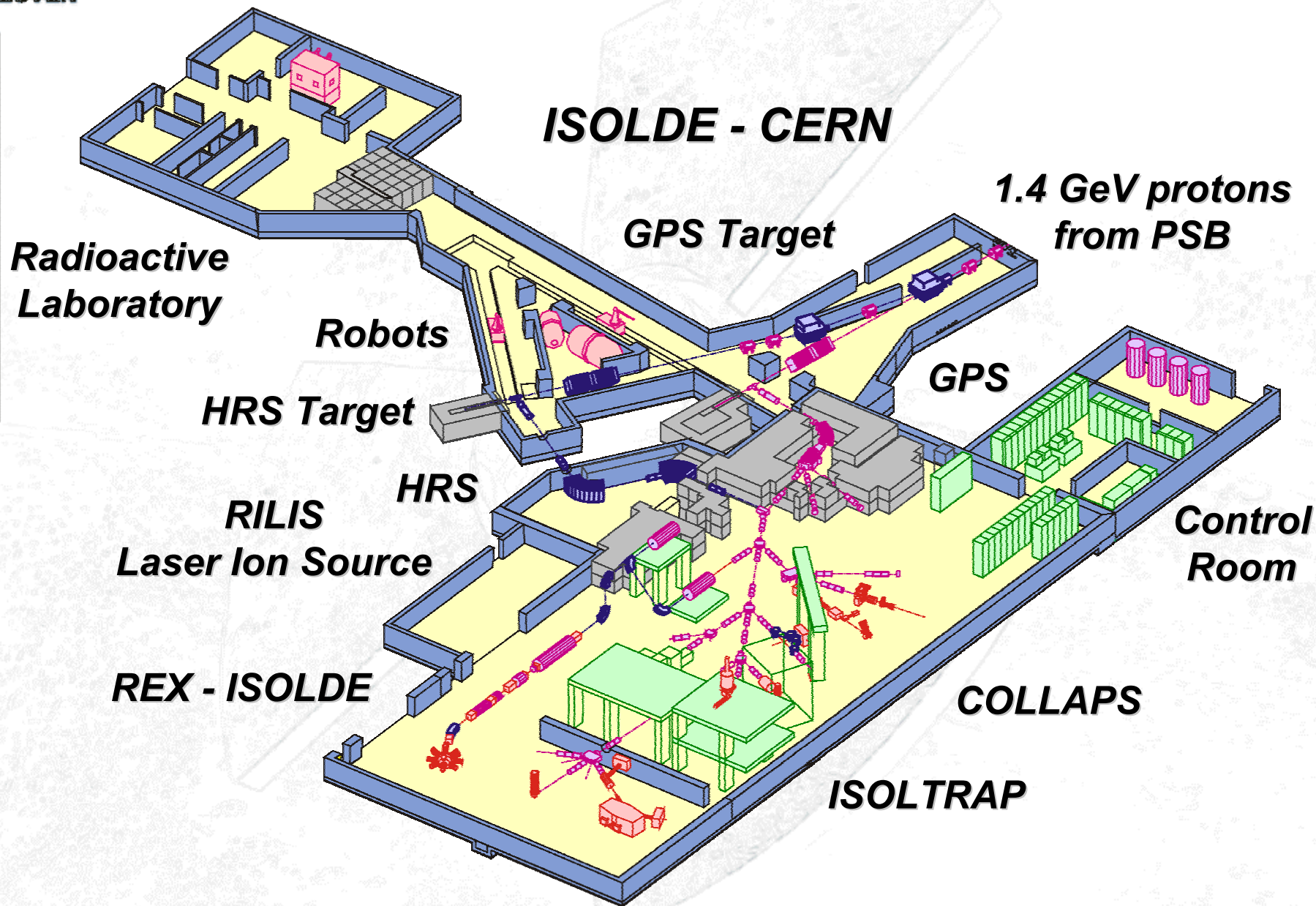
>6.6

5.27(26)

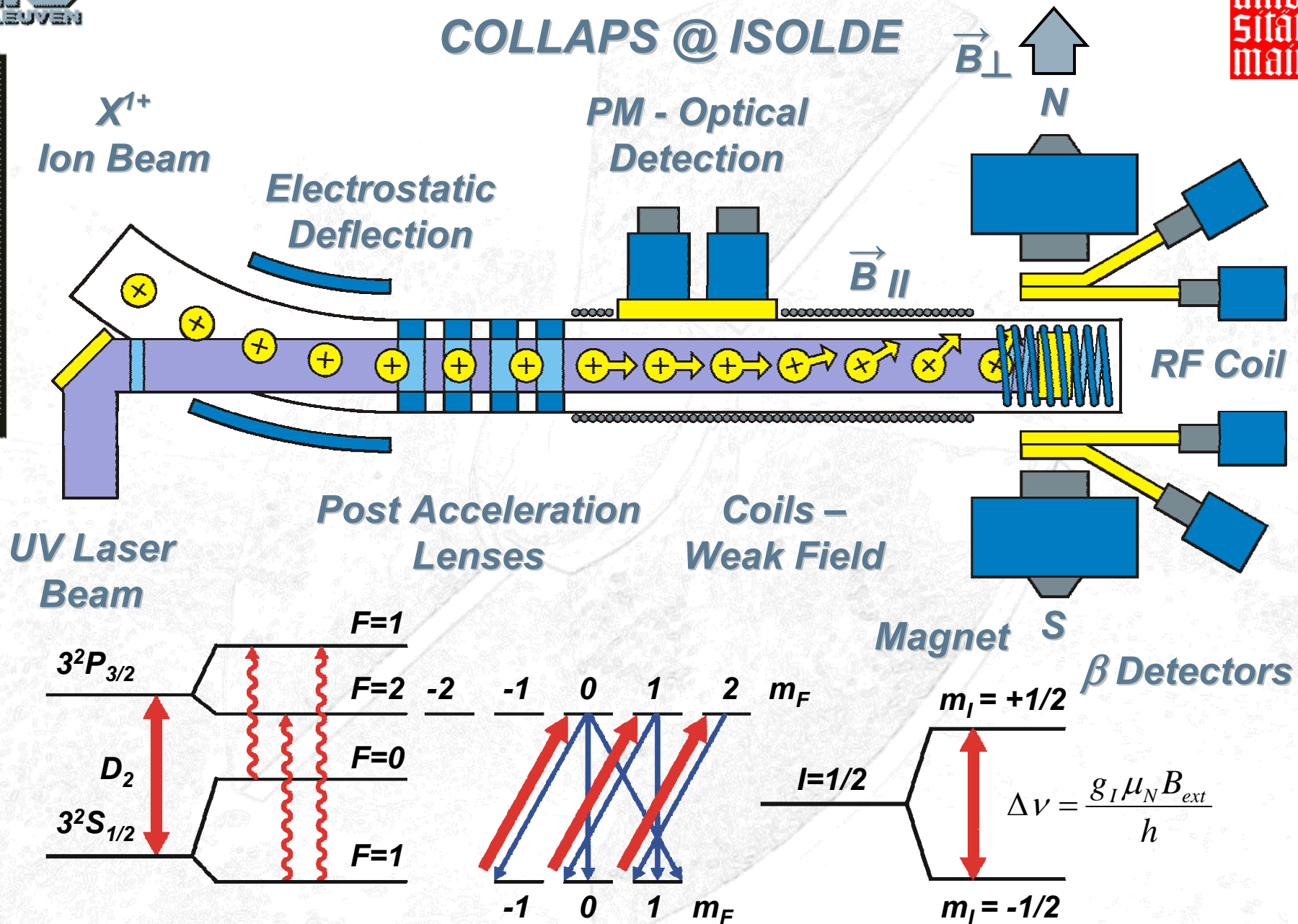


Conclusions & Outlook

- ✓ *^{33}Mg has a nearly pure 2p2h intruder ground state*
- ✓ *The first excited states also have intruder nature*
- ✓ *Investigate neutron deficient Mg*
- ✓ *Access the deformation through rms charge radii*



COLLAPS @ ISOLDE



Nuclear Magnetic Resonance

Nuclear Orientation

$$P = \sum_{m_I} m_I W(m_I) / I$$

$$W(\theta) \approx 1 + (v/C) P A \cos(\theta)$$

$$\beta_{\text{asymmetry}} = \frac{N(0) - N(\pi)}{N(0) + N(\pi)}$$

$$\Delta E_{\text{nucleus}} = h\nu = g_I \mu_N B_{\text{ext}}$$

HyperFine Structure

$$\mathbf{F} = \mathbf{I} + \mathbf{J}$$

$$A = g_I \mu_N B(0) / J$$

$$B = eQ \partial^2 V / \partial z^2$$

